

**Facility and Project Safety Assessment of the  
Center for Nanophase Materials Sciences (CNMS)**

**Revision 1  
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## **Facility and Project Safety Assessment of the Center for Nanophase Materials Sciences (CNMS)**

### **Purpose**

This safety assessment identifies and evaluates the hazards associated with the project that could have a potential impact on adjacent facilities in the event of an accident. This assessment was originally documented in Oak Ridge National Laboratory Chemical and Analytical Sciences Division Standard Operating Procedure CSD-HS-CNMS-R0, Facility and Project Safety Assessment of the Center for Nanophase Materials Sciences, issued November 27, 2001.

### **Evaluation**

The attached hazards screening worksheet (Table 1) was completed to identify potential hazards associated with the proposed project. Construction activities for this building are subject to industry standards requiring the appropriate safeguards to control hazards. The proposed construction will use standard safeguards and construction techniques.

In operation, this facility will house research activities including the synthesis, fabrication, characterization, and theoretical description of research quantities of novel nanophase materials. Synthesis and fabrication tasks will require the use of laboratory quantities of flammable, corrosive, reactive, and toxic (hazardous) materials. The types and maximum quantities of these chemicals, anticipated to be in use and/or storage in the facility are listed in Table 2A-F. The chemicals listed will be distributed among numerous individual fire areas and within the limits established by the National Fire Protection Association (NFPA) and the 1997 Standard Building Code (SBC). Additionally, these materials will be handled and stored according to OSHA Laboratory Standards (29 CFR 1910.1450) and ORNL guidelines and rules. Characterization tasks will include the use of lasers and x-ray facilities that will be installed and operated under applicable ANSI Standards. No generation of radioactive waste or use of radioactive materials is currently projected for this facility (with the exception of standard industrial, sealed calibration sources). Primary hazards associated with this facility are those commonly encountered in chemical, x-ray, and laser laboratories. These are considered to be "standard industrial hazards."

Prior to all research activities and processes shall be reviewed following the ORNL Integrated Safety Management tool for work control, the Research Hazard Analysis and Control System. This system is designed to identify and control all ES&H hazards associated with research activities.

### **Conclusion**

In accordance with the ORNL Facility Safety Documentation Program, ORNL-FS-P02, the new CNMS is determined to be an "Other Industrial" facility, which will not contain any radiological material. Therefore no additional safety analysis document is required beyond that specified by ORNL-SH-P29, Job Hazard Evaluations. The ORNL Research and Development Work Control Process will be used to evaluate and establish appropriate controls for all experimental activities in the completed facility. The construction project activity is considered as "Other Industrials" based on the site location and the use of standard industrial guidelines. The analysis of CNMS relative to the building occupancy classification is presented in Appendix A.

**Table 1. Hazard Identification and Screening**

Hazard or Challenge	Present or Possible in	Qualitative Assessment	Design Safety Assurance Measures	Design Criteria
Fire	All	Standard industrial hazard	Minimize combustible & flammable materials, and maintain storage & use to within specified limits. Fire protection engineering features, as specified in NFPA Standards & Building Codes.	Maximum acceptable quantities have been established. Addition of combustible or flammable materials must be reviewed in "work planning."
Radioactive Materials	Not present (e.g., >0.002 Ci/gm)	Standard industrial hazard	Commercial sealed calibration sources	Commercially available products.
Radiation Generating Devices (e.g., x-ray)	Electron microscopy labs & x-ray diffraction laboratories	Standard industrial hazard	Adhere to ORNL requirements for operation & training of operators	10CFR835 ORNL Subject Area: Radiation Generating Devices
Hazardous Chemicals (i.e., flammable, reactive, explosive, toxic chemicals, & chemical compatibility)	All laboratories	Standard industrial hazard	Laboratory designed with safety features/controls to accommodate use & storage. Adhere to quantity limits set by NFPA & Standard Building Codes.	1997 Standard Building Code (SBC) 29CFR1910 (OSHA) 40 CFR (EPA) ORNL Chemical Safety
Lasers	Laser nano materials synthesis, laser diagnostics, pulsed laser depts., & magnetic materials growth labs	Standard industrial hazard	Commercially designed & built lasers. Research hazard analysis & controls required and applied to laser operations.	Design, operation, & maintenance compliant with ANSI Laser Standards & ORNL Laser Safety Program (ORNL-SH-P17).
Electrical energy, including high voltage	Essentially all	Standard industrial hazard	Installations follow consensus electrical standards or provide equivalent safety features. Specific safety design requirement(s) or standards for high voltage accelerator and related equipment shall be provided by partner labs for the areas under their design purview.	OSHA 29CFR 1910, Subpart S; ORNL Standard ORNL-SH-P25 <i>ORNL Electrical Safety Program</i> ; ORNL OSHP-59, <i>Lockout/Tagout of Hazardous Energy Sources</i>
Nonionizing radiation	CVD, furnace, electrical & magnetic characterization, bulk crystal growth, and UHV scanning laboratories	Standard industrial hazard	During installation, evaluate potential for radio frequency (rf) and microwave problems during design; ensure inclusion of adequate control/prevention features. Design confirmed by pre-operational surveys.	ORNL-SH-P18, <i>ORNL Nonionizing radiation Safety Program</i> 29CFR 1910.97 limits on microwave radiation in accessible areas.
Internal pressure & vacuum	Electron microscopy and other analytical laboratories	Standard industrial (cryogenic) hazard	Provision of safe relief path, if potential exists for internal pressurization. Utilize commercially designed &	Reviewed & approved in work planning

**Table 1. Hazard Identification and Screening**

Hazard or Challenge	Present or Possible in	Qualitative Assessment	Design Safety Assurance Measures	Design Criteria
			handling equipment.	
Internal pressure	Piping, process, and R&D systems	Standard industrial hazard	Provision of adequate relief per consensus industry codes and standards.	ASME standards followed where applicable.
Asphyxiant gases	Potentially all laboratories (no confined spaces)	Standard industrial hazard	Limit quantities of asphyxiant gases and ensure adequacy of ventilation prior to storage and use	NFPA 29CFR 1910 (OSHA)

Table 2 Identified CNMS Hazardous Materials

<b>Table A</b> <b>Proposed In-Use Quantities of Hazardous Materials in CNMS Hard Materials Laboratories</b>		
<b>H2 Materials</b>	<b>Proposed In-Use Quantity in CNMS Hard Materials Laboratories</b>	<b>Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3A)<sup>1,2</sup></b>
Flammable Gases (m <sup>3</sup> )	81.3 <sup>b</sup>	42.5
Liquefied Flammable Gases (liters)	0	114
Oxidizers (kg) - Class 3	0	1.8 Solid / 1.8 Liquid
Organic Peroxides (kg) - Class I	0	0.91 Solid / 0.91 Liquid
Pyrophoric Materials (kg)	0	0.45 Solid / 0.45 Liquid
Pyrophoric Gases (m <sup>3</sup> )	1.2 <sup>b</sup>	0.6 <sup>a</sup>
Unstable Materials (kg) - Class 3	0	0.91 Solid / 0.91 Liquid
Unstable Gases (m <sup>3</sup> ) - Class 3	0	0.6
<b>H3 Materials</b>	<b>Proposed In-Use Quantity in CNMS Hard Materials Laboratories</b>	<b>Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3A)<sup>1,2,3</sup></b>
Flammable Liquids (liters) - IA, IB, or IC	50	681
Flammable Solids (kg)	1	23
Oxidizers (kg) - Class 1 or 2	0	227
Gaseous Oxidizers (m <sup>3</sup> )	98.7 <sup>b</sup>	85
Organic Peroxides (liters) - Class II, III, or IV	0	37
Unstable Materials (kg) - Class 1 or 2	0	45
Unstable Gases (m <sup>3</sup> ) - Class 2	16.166 <sup>b</sup>	14.2
Water Reactives (kg) - Class 1, 2, or 3	0	4.5
Flammable / Oxidizing Cryogens	0	341
<b>H4 Materials</b>	<b>Proposed In-Use Quantity in CNMS Hard Materials Laboratories</b>	<b>Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3B)<sup>1,2</sup></b>
Highly Toxic Gases (m <sup>3</sup> )	0	1.1 <sup>a</sup>
Toxic Gases (m <sup>3</sup> )	0.8	36.8 <sup>a</sup>
Highly Toxic Solids (kg)	1.0 <sup>b</sup>	0.9
Highly Toxic Liquids (kg)	0	0.9
Toxic Solids (kg)	0	454
Toxic Liquids (kg)	0	454
Other Solids <sup>4</sup> (kg)	0	4536
Other Liquids <sup>4</sup> (liters)	40	3785
Other Gases <sup>4</sup> (m <sup>3</sup> )	15.1	73.6 <sup>a</sup>

**General Notes**<sup>1</sup> **Storage and use is in sprinklered building, not in cabinet, unless otherwise noted.**<sup>2</sup> Use of materials is assumed to be in a closed system or in a ventilated hood, unless otherwise noted.<sup>3</sup> Exempt amount indicated is for the highest hazard class material within the material category, except for flammable liquids where the exempt amount indicated assumes 50% 1A flammables and 50% 1B flammables<sup>4</sup> Corrosives, Irritants, Sensitizers, and Other Health Hazard materials not considered toxic or highly toxic.**Special Requirements**<sup>a</sup> Storage and use within a cabinet<sup>b</sup> To not exceed SBC use exempt limits the inventory of this hazardous material is required to be subdivided into at least two separate Hazardous Material Control Areas within the CNMS Hard Materials Laboratories

Table 2 Identified CNMS Hazardous Materials (continued)

Table B Proposed In-Use Quantities of Hazardous Materials in CNMS Soft Materials Laboratories		
H2 Materials	Proposed In-Use Quantity in CNMS Soft Materials Laboratories	Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3A) <sup>1,2</sup>
Flammable Gases (m <sup>3</sup> )	26.6	42.5
Liquefied Flammable Gases (liters)	0	114
Oxidizers (kg) - Class 3	0	1.8 Solid / 1.8 Liquid
Organic Peroxides (kg) - Class I	0.9	0.91 Solid / 0.91 Liquid
Pyrophoric Materials (kg)	0	0.45 Solid / 0.45 Liquid
Pyrophoric Gases (m <sup>3</sup> )	0	0.6 <sup>a</sup>
Unstable Materials (kg) - Class 3	0	0.91 Solid / 0.91 Liquid
Unstable Gases (m <sup>3</sup> ) - Class 3	0	0.6
H3 Materials	Proposed In-Use Quantity in CNMS Soft Materials Laboratories	Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3A) <sup>1,2,3</sup>
Flammable Liquids (liters) - IA, IB, or IC	600.8	681
Flammable Solids (kg)	0	23
Oxidizers (kg) - Class 1 or 2	0	227
Gaseous Oxidizers (m <sup>3</sup> )	28	85
Organic Peroxides (liters) - Class II, III, or IV	0	37
Unstable Materials (kg) - Class 1 or 2	3.3	45
Unstable Gases (m <sup>3</sup> ) - Class 2	0.9	14.2
Water Reactives (kg) - Class 1, 2, or 3	2.5	4.5
Flammable / Oxidizing Cryogenics	0	341
H4 Materials	Proposed In-Use Quantity in CNMS Soft Materials Laboratories	Use Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 407.3B) <sup>1,2</sup>
Highly Toxic Gases (m <sup>3</sup> )	0	1.1 <sup>a</sup>
Toxic Gases (m <sup>3</sup> )	0.8	36.8 <sup>a</sup>
Highly Toxic Solids (kg)	0.5	0.9
Highly Toxic Liquids (kg)	0.8	0.9
Toxic Solids (kg)	5	454
Toxic Liquids (kg)	10	454
Other Solids <sup>4</sup> (kg)	0	4536
Other Liquids <sup>4</sup> (liters)	150	3785
Other Gases <sup>4</sup> (m <sup>3</sup> )	0.5	73.6 <sup>a</sup>

**General Notes**<sup>1</sup> Storage and use is in sprinklered building, not in cabinet, unless otherwise noted.<sup>2</sup> Use of materials is assumed to be in a closed system or in a ventilated hood, unless otherwise noted.<sup>3</sup> Exempt amount indicated is for the highest hazard class material within the material category, except for flammable liquids where the exempt amount indicated assumes 33% 1A flammables and 66% 1B flammables<sup>4</sup> Corrosives, Irritants, Sensitizers, and Other Health Hazard materials not considered toxic or highly toxic.**Special Requirements**<sup>a</sup> Storage and use within a cabinet

Table 2 Identified CNMS Hazardous Materials (continued)

Table C Proposed Storage Quantities of Hazardous Materials in CNMS Chemical & Gas Storage Area		
H2 Materials	Proposed Storage Quantity in CNMS Chemical & Gas Storage Area	Storage Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 308.2B) <sup>1</sup>
Flammable Gases (m <sup>3</sup> )	116.8 <sup>b</sup>	42.5
Liquefied Flammable Gases (liters)	0	114
Oxidizers (kg) - Class 3	0	9.1
Organic Peroxides (kg) - Class I	0.45	4.5
Pyrophoric Materials (kg)	0	1.8
Pyrophoric Gases (m <sup>3</sup> )	0.98	2.8 <sup>a</sup>
Unstable Materials (kg) - Class 3	0	4.5
Unstable Gases (m <sup>3</sup> ) - Class 3	0	2.8
H3 Materials	Proposed Storage Quantity in CNMS Chemical & Gas Storage Area	Storage Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 308.2C) <sup>1,3</sup>
Flammable Liquids (liters) - IA, IB, or IC	372	681
Flammable Solids (kg)	1	113
Oxidizers (kg) - Class 1 or 2	12	227
Gaseous Oxidizers (m <sup>3</sup> )	148.3 <sup>b</sup>	85
Organic Peroxides (liters) - Class II, III, or IV	0	37
Unstable Materials (kg) - Class 1 or 2	2	45
Unstable Gases (m <sup>3</sup> ) - Class 2	1.39	14.2
Water Reactives (kg) - Class 1, 2, or 3	2	4.5
Flammable / Oxidizing Cryogenics	0	341
H4 Materials	Proposed Storage Quantity in CNMS Chemical & Gas Storage Area	Storage Exempt Quantity in a Single Hazardous Material Control Area (SBC Table 308.2D) <sup>1</sup>
Highly Toxic Gases (m <sup>3</sup> )	2.87 <sup>c</sup>	1.1 <sup>a</sup>
Toxic Gases (m <sup>3</sup> )	16.77	73.6 <sup>a</sup>
Highly Toxic Solids (kg)	0	0.9
Highly Toxic Liquids (kg)	.5	Included in highly toxic solids
Toxic Solids (kg)	0	454
Toxic Liquids (kg)	1.5	Included in toxic solids
Other Solids <sup>4</sup> (kg)	0	4536
Other Liquids <sup>4</sup> (liters)	460	3785
Other Gases <sup>4</sup> (m <sup>3</sup> )	88.55 <sup>b</sup>	73.6 <sup>a</sup>

**General Notes**<sup>1</sup> Storage and use is in sprinklered building, not in cabinet, unless otherwise noted.<sup>3</sup> Exempt amount indicated is for the highest hazard class material within the material category, except for flammable liquids where the exempt amount indicated assumes 33% 1A flammables and 66% 1B flammables<sup>4</sup> Corrosives, Irritants, Sensitizers, and Other Health Hazard materials not considered toxic or highly toxic.**Special Requirements**<sup>a</sup> Storage and use within a cabinet<sup>b</sup> To not exceed SBC storage exempt limits part of this inventory is required to be stored outside.<sup>c</sup> To not exceed SBC storage exempt limits part of this inventory is required to be stored in the designated H4 storage room



**Table 2 Identified CNMS Hazardous Materials (continued)**

<b>Table D</b> <b>Classification of Hazardous Materials Proposed for Use in the</b> <b>CNMS Soft Materials Laboratories and CNMS Hard Materials Laboratories</b> <b>and for Storage in the CNMS Chemical &amp; Gas Storage Area</b>	
<b>H2 Materials</b>	
Flammable Gases (m <sup>3</sup> )	<u>Hydrogen, Acetylene, Hydrogen sulfide, Methylsilane, 10% Methylsilane in He, 10% Ammonia in Hydrogen, Propane, 1,3-Butadiene, Ethylene Oxide (in N<sub>2</sub>)</u>
Liquefied Flammable Gases (liters)	
Oxidizers (kg) - Class 3	
Organic Peroxides (kg) - Class I	Benzoyl peroxide
Pyrophoric Materials (kg)	Na, K
Pyrophoric Gases (m <sup>3</sup> )	Digermene, Disilane, Silane, 10% Digermene in He, 10% Disilane in He, 10% Silane in He
Unstable Materials (kg) - Class 3	
Unstable Gases (m <sup>3</sup> ) - Class 3	
<b>H3 Materials</b>	
Flammable Liquids (liters) - IA, IB, or IC	<u>Acetone, Alcohols, Ethers, Picric Acid</u>
Flammable Solids (kg)	Magnesium
Oxidizers (kg) - Class 1 or 2	
Gaseous Oxidizers (m <sup>3</sup> )	1% Fluorine in Ne/Kr/He, 5% Fluorine in He, Oxygen, Nitrous oxide, Oxygen
Organic Peroxides (liters) - Class II, III, or IV	
Unstable Materials (kg) - Class 1 or 2	Na, K, Picric Acid
Unstable Gases (m <sup>3</sup> ) - Class 2	Digermene, Disilane, Silane, 10% Digermene in He, 10% Disilane in He, 10% Silane in He, 1,3-Butadiene, Ethylene Oxide (in N <sub>2</sub> )
Water Reactives (kg) - Class 1, 2, or 3	Na, K
Flammable / Oxidizing Cryogens	
<b>H4 Materials</b>	
Highly Toxic Gases (m <sup>3</sup> )	
Toxic Gases (m <sup>3</sup> )	Hydrogen sulfide, 5% Fluorine in He, Silane, Ethylene Oxide (in N <sub>2</sub> )
Highly Toxic Solids (kg)	Arsenic, Arsenic oxide, Cadmium, Cadmium oxide, Tellurium, Potassium cyanide, NN-Dimethyl-1,4-phenylenediamine
Highly Toxic Liquids (kg)	Methylacrylic anhydride, Tributyl amine
Toxic Solids (kg)	Diethyl diphenyl urea, Dimethyl phenol
Toxic Liquids (kg)	Carbon disulfide, Chloroform, Diallylamine
Other Solids <sup>4</sup> (kg)	
Other Liquids <sup>4</sup> (liters)	Acids, Bases, HCl, HNO <sub>3</sub> , NaOH, NH <sub>4</sub> OH
Other Gases <sup>4</sup> (m <sup>3</sup> )	Ammonia, Hydrogen chloride, Methylsilane, 5% Hydrogen chloride in He, 10% Ammonia in He, 1% Fluorine in He, 10% Silane in He, 1,3-Butadiene



**Table 2 Identified CNMS Hazardous Materials (continued)**

<b>Table E</b> <b>Proposed Quantities of Hazardous Materials in</b> <b>CNMS Cleanroom Fabrication Area</b>		
<b>Hazardous Materials</b>	<b>Proposed Quantity in Cleanroom Fabrication Area</b>	<b>Permitted in a Single HPM Fabrication Area (SBC Table 408.3.3B)<sup>1</sup></b>
Flammable Liquids (liters) IA, IB, or IC	120.5	341
Flammable Gases (m <sup>3</sup> )	60.2	255
Liq Flam Gases (liters)	0	681
Flammable Solids (kg)	0	680
Corrosive Liquids <sup>4</sup> (liters)	400	624
Gaseous Oxidizers (m <sup>3</sup> )	61.5	510
Oxidizers - Liquid (kg)	12	568
Oxidizers - Solid (kg)	0	680
Organic Peroxides (kg)	0	13.6

<sup>1</sup> Pyrophoric Gases, Highly Toxic Gases, and Toxic Gases included in the aggregate for flammable gas quantities per direction in SBC Table 408.3.3B

<b>Table F</b> <b>Classification of Hazardous Materials Proposed for Use in the</b> <b>CNMS Cleanroom Fabrication Area</b> <b>(Per SBC Table 408.3.3B)</b>	
Flammable Liquids (liters) IA, IB, or IC	Acetone, Alcohols (isopropyl, methanol, ethanol), Hexamethyldisilazane (HMDS)
Flammable Gases (m <sup>3</sup> )	Dichlorosilane, 5% Silane in He, Hydrogen, Methane, 1-15% Diborane (B <sub>2</sub> H <sub>6</sub> ) + 1-50% Silane in He, Phosphine, Arsine, Boron trichloride, Chlorine, Nitrogen trifluoride (NF <sub>3</sub> ), Silicon tetrachloride (SiCl <sub>4</sub> ), Boron trichloride
Liquified Flammable Gases (liters)	
Flammable Solids (kg)	
Corrosive Liquids <sup>4</sup> (liters)	Acids (Sulfuric, acetic, HF-buffered to 50%, nitric, HCl), Bases (ammonia)
Gaseous Oxidizers (m <sup>3</sup> )	Nitrogen trifluoride (NF <sub>3</sub> ), Chlorine, Oxygen, Carbon tetrafluoride in oxygen, Nitrous oxide
Oxidizers - Liquid (kg)	Hydrogen peroxide solution
Oxidizers - Solid (kg)	
Organic Peroxides (kg)	

## **Appendix A**

### **Hazardous Material Occupancy Analysis of the Center for Nanophase Materials Sciences (CNMS) Facility**

#### **Purpose**

The purpose of this analysis is to determine if the CNMS facility design is capable of supporting the types and quantities of hazardous materials proposed for use and storage in the building.

#### **Code of Record**

1997 Standard Building Code (SBC)

#### **Hazardous Material and Occupancy Classification Requirements**

Hazardous materials not exceeding the exempt quantities in SBC Tables 308.2A, 308.2B, 308.2C, and 308.2D are permitted in a building not classified as a Group H (Hazardous) Occupancy. Areas of a building containing exempt quantities of hazardous materials are defined as hazardous material control areas. Each control area requires separation by 1-hour fire resistant construction with 0.75 hour opening protection. The maximum number of control areas per floor in a multi-story building such as the CNMS is four. The total number of control areas allowed in a building such as the CNMS is ten (SBC Section 308.2.2).

The quantities of hazardous materials that can be in-use (dispensing, use, and handling) in a control area is further restricted by SBC Tables 407.3A and 407.3B. If the in-use amount of hazardous materials exceeds the quantities listed in these tables, the room or area needs to be classified as a Group H (Hazardous) Occupancy (SBC Section 407.3).

The SBC recognizes the use and storage of hazardous materials in semiconductor fabrication facilities (cleanrooms) and areas of compatible research and development as being a unique occupancy. Provided the quantities of hazardous materials in a fabrication area do not exceed the quantities listed in SBC Table 408.3.3.B, a fabrication area is classified as a Hazardous Production Material (HPM) Occupancy. Facility design requirements associated with HPM Occupancies are identified in SBC Section 408.

#### **Proposed Quantities and Types of Hazardous Materials in the CNMS**

Proposed in-use quantities of hazardous materials in the CNMS Hard Materials Laboratories are listed in Table 2-1A in the CNMS ES&H Plan. To not exceed SBC use exempt limits, the proposed inventory of flammable gases, pyrophoric gases, gaseous oxidizers, Class 2 unstable gases, and highly toxic solids will be required to be subdivided into at least two separate hazardous material control areas within the CNMS Hard Materials Laboratories (see endnote b in Table 2-1A).

Proposed in-use quantities of hazardous materials in the CNMS Soft Materials Laboratories are listed in Table 2-1B in the CNMS ES&H Plan. The quantities are below the in-use limits for a single hazardous materials control area.

Proposed storage quantities of hazardous materials in the CNMS Chemical & Gas Storage Area are listed in Table 2-1C in the CNMS ES&H Plan. To not exceed SBC storage exempt limits, part of the inventory of flammable gases, gaseous oxidizers, and other gases will be required to be stored outside (see endnote c in Table 2-1C). In addition, to not exceed SBC storage exempt limits, the proposed inventory of highly toxic gases is required to be stored in a designated H4 storage room (see endnote d in Table 2-1C).

**Table 2-1D in the CNMS ES&H Plan lists the types of hazardous materials that have been identified for use in the CNMS Soft Materials Laboratories and CNMS Hard Materials Laboratories and for storage in the CNMS Chemical & Gas Storage Area and the associated hazardous classification of the proposed materials.**

Proposed quantities of hazardous materials in the CNMS Cleanroom Fabrication Area are listed in Table 2-1E in the CNMS ES&H Plan. The quantities are below the limits for a single HPM fabrication area. Table 2-1F in the CNMS ES&H Plan lists the types of hazardous materials that have been identified for use in the CNMS Cleanroom Fabrication Area and the associated hazardous classification of the proposed materials.

### **Facility Design**

In summary, the proposed inventory of hazardous materials in the CNMS requires:

- 1) a minimum of four hazardous material control areas (two in the hard materials lab areas, one in the soft material lab areas, and one for the hazardous materials storage area).
- 2) the designation of the cleanroom fabrication area as a HPM fabrication area.
- 3) a room classified as a Group H4 Occupancy.
- 4) an outside gas cylinder storage area.
- 5) an automatic fire sprinkler system throughout the facility.

The CNMS facility design meets the requirements that the hazardous materials inventory places on the building. In addition, the CNMS facility design provides the flexibility to define additional hazardous material control areas (up to the ten maximum allowed by code) should the inventory of hazardous materials increase over that which has been currently proposed.

### **Conclusion**

**The CNMS facility infrastructure and the related occupancy classification are capable of supporting the types and quantities of hazardous materials proposed for use and storage in the building.**